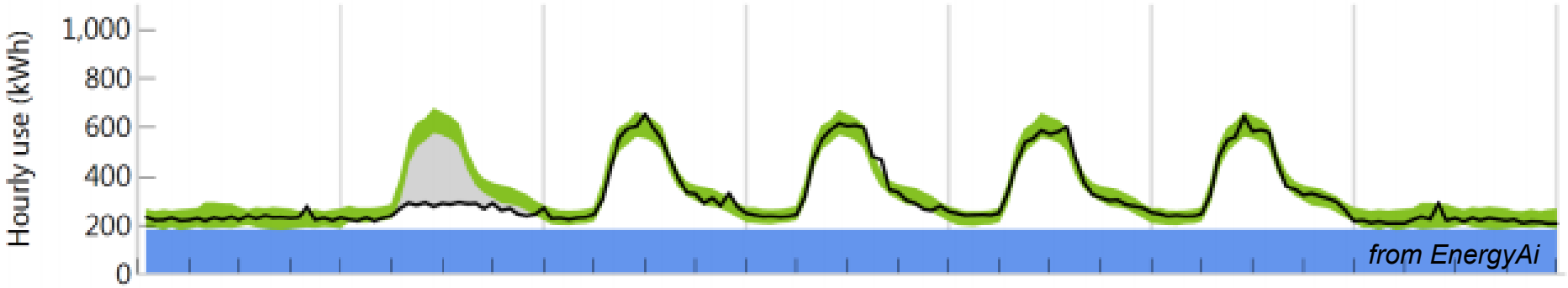
Energy Management Package for Small Commercial Buildings

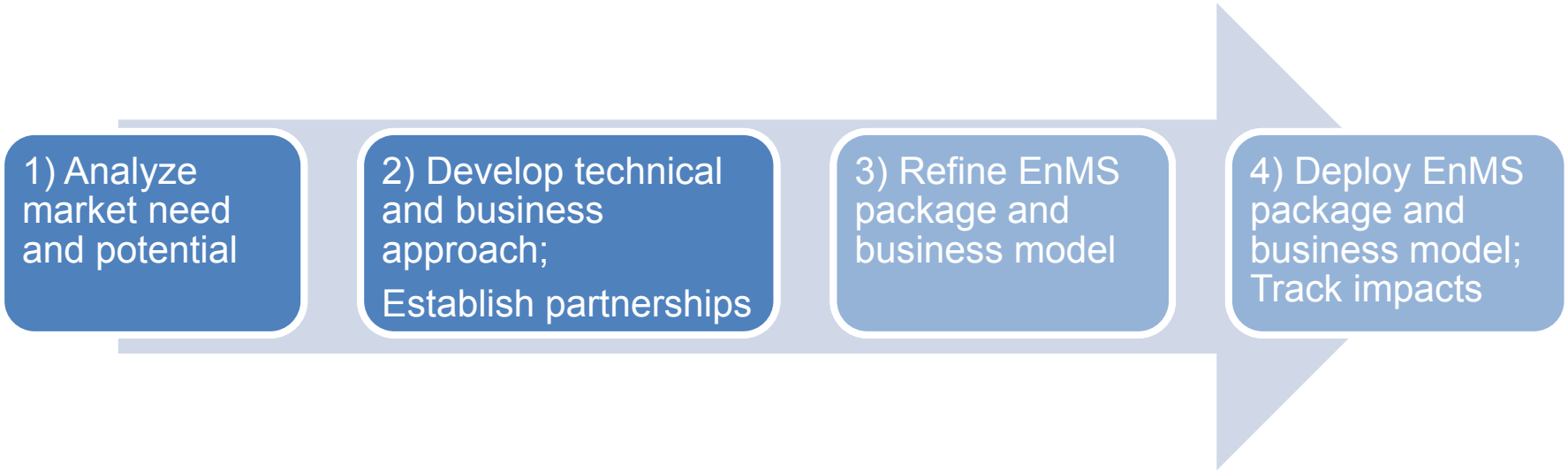
Jessica Granderson, Erin Hult, Paul Mathew
Lawrence Berkeley National Laboratory
June 2013



EnMS for Small Commercial Buildings

Goal:

- Develop packaged, highly 'commoditized' EnMS solutions
  - EnMS: Energy Management System
- Low transaction costs in terms of both skills and level of effort
- Elements: Benchmarking, analysis of energy use data, walkthrough.
- Stakeholders: HVAC contractors, EIS vendors, utilities
- Segments: Office, retail, food sales, and food service



Meeting Agenda

1. Scoping Study Findings
2. EnMS Package Technical Elements
3. Business Model
4. Next Steps

Feedback:

- *Too complicated / Too basic?*
- *Too time consuming?*
- *Who would do this? Do they have the skills?*
- *How would this fit into your business structure?*
- *What format should this have?*

17 Stakeholder Interviews

4 Contractors, 2 Contractor associations

- Mix of client bases: small businesses, larger portfolios, schools
- ACCA directors in Michigan, Florida – could serve as an information channel

6 Utility programs

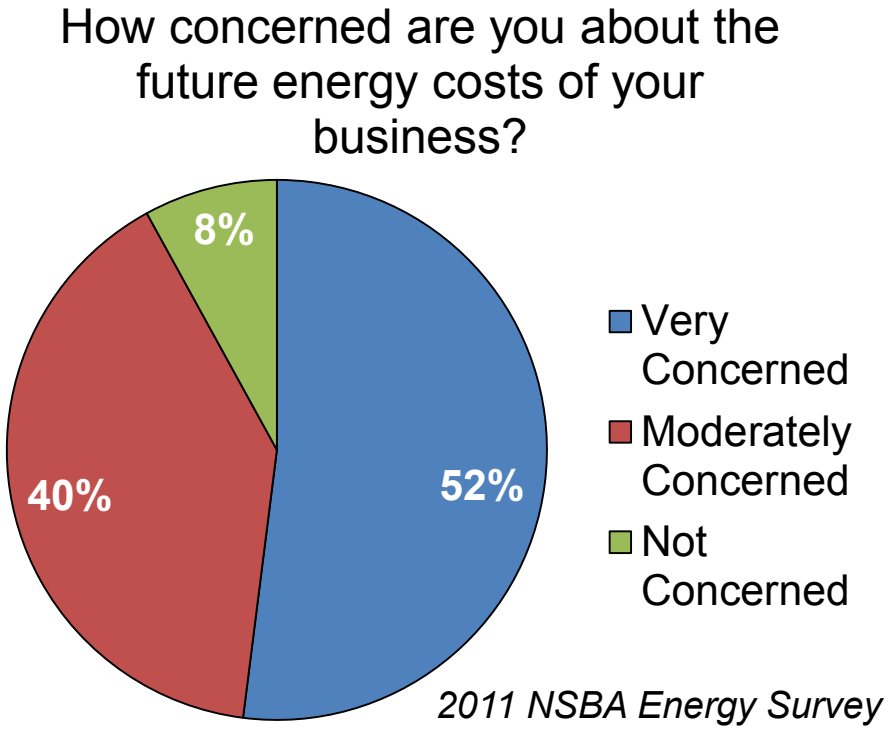
- **PPL-Pennsylvania**: Brian Stafford, runs contractor-based direct install program
- **PECI**: Emily Pearce, program manager for AirCarePlus for PG&E
- **Energy Trust of Oregon**: Spencer Moersfelder, Business Sector Manager
- **Reliant**: Paul Keene, VP of Middle Markets (SMB)
- **TouchStone Energy**: Tim Sullivan, Senior Director of Business Development
- **BC Hydro**: Graham Henderson, Senior Program Manager, Commercial Marketing

6 EIS vendors

- **NorthWrite**, Patrick O'Neill, Founder & CEO
- **EnergyAi**, Dave Krinkel, Founder
- **Pulse**, Bruce Herzer, Director of Marketing and Regulatory Affairs
- **Lucid**, Michael Murray, CEO
- **C3 Energy**, Ed Abbo, President & CTO
- **WegoWise**, Dan Teague and Craig Isakow

Scoping Study Findings

- Substantial energy use in Retail, Office, Food Sales, Food Service
- Underserved for Energy Management: low-cost opportunities exist
- Owner awareness varies
- Tools for larger buildings typically expensive & complex
- Occasional programs & tools, but not a single, straightforward tool that combines relevant pieces



2011 NSBA Energy Survey

Scoping Study Findings

Simple and inexpensive:

"…even if you have to give up on a level of accuracy, the most important thing is for tools to be simple and easy." - Utility program interviewee

"[Most contractors]...won't take the time to have their employees get the training [on tools]." - Contractor association interviewee

"Even if you have great ways of slicing and dicing, there isn't the time or expertise at the facility level to use that information (often even at large organizations)" - EIS vendor

Direct, actionable information:

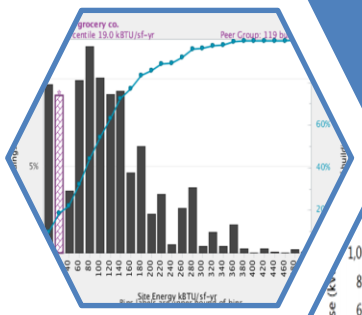
"*How much did I save*?", "*Is my building on target*?"

Two interviewees said that a simple one-page report for the owner is likely to be more effective than dynamic on-line tools.

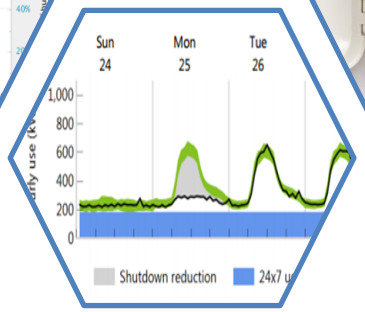
"With more interval data available, there is a slowly growing opportunity for a very simple, very cheap tool that can pick out dominant patterns... and deviations from those patterns and present that information in a simple format." - EIS vendor

Technical Elements

Analyze monthly data & benchmark



Analyze interval data



Walkthrough

Communicate with owner

Check results

Technical Elements

Activity	Package elements
Analyze utility data & Benchmark relative to peers	Template for gathering information URL, instructions for tools: Screenshots, sample output/report How to interpret output; Next steps
Walkthrough	Checklist of things to look for, for example - programmed thermostat - occupancy sensors, location & presence Information on how to fix problems Tracking spreadsheet
Analyze interval data (hourly, 15min)	How to obtain data, data request letter template Description of available tools / services, sample reports Tips on interpreting data
Communicating with owner	Automated template to compile results Identify incentives Tips on working with owner to set goals & take action
Check results	Instructions for tool How to calculate continuous savings over time Tips on how to proceed

Technical Elements: Monthly Data & Benchmarking

What does this element offer?

- Show upward/downward trends
- Compare energy use with peers
  - *How much could I save?*

Source: Abraxas Energy Consulting

What would the package provide?

- Guidelines for analysis
  - *What to look for in monthly data?*
  - *What does an EnergyStar score of 60 mean?*
- Worksheet
- Instructions & URLs for online tool use:
  - EnergyStar Portfolio Manager
  - EnergyIQ
  - FirstView
- Next steps if score is good or bad

E1 Benchmarking and Analysis of Monthly Energy Use

Plan to spend about 30-40 minutes on this element, including uploading the data

A list of tools that you could use for this analysis is provided at the end of these guidelines. The tools listed are generally intuitive to use and provide tool-specific instructions online.

Step 1 Gather & upload data

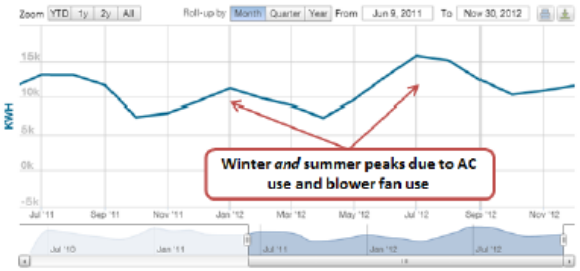
Gather ideally two years of monthly electricity and gas/oil use data (if two years is not available, use whatever is available). This can be downloaded from a utility website (see Obtaining Data in the Overview) or gathered from paper utility bills. Using an electronic file is highly recommended if possible, as manual data entry can be very time intensive.

Record additional building characteristics such as building type, floor area and year built on the Worksheet.

Step 2 Patterns in monthly energy use

Use a monthly energy analysis tool to plot the last year's energy use data. Look at total energy as well as fuel (gas, oil) and electricity.

- If you typed in your energy data by hand in Step 1, look for any data entry errors indicated by significant deviations from the annual pattern and verify that data is entered correctly.
- Look at the electricity and gas use pattern over the year: typically electricity use increases during periods of heavy air conditioner use in the summer, and gas or oil usage increases with heating use during the winter.
- Food Service and food sales buildings may have high equipment loads that dominate seasonal conditioning trends.



Monthly electricity use plotted over time using Noesis.

Note seasonal patterns in energy usage, displaying electricity and fuel use separately.

E1 Benchmarking and Monthly Data Analysis Worksheet

Building:_____ City:_____ Zip:_____ Date:_____

STEP 1 Gather Data

Who pays electricity and gas bills? owner tenant Name: _____
Is energy use or cost currently tracked? yes no how?_____

Either: ☐ Get paper utility bills from owner/tenant. Get two or more years if available.
☐ Download from utility website. Filename:_____ Utility: _____
Username:_____ Password: _____
☐ Other: _____

Building type (circle): office retail food service food sales other_____
Floor area: _____ **Year built:** _____
Tool(s) used: _____ Username:_____ Password: _____

Note: Some tools can automatically generate a summary report. Use this worksheet to highlight key elements on the summary report and supplement that information where needed.

STEP 2 Patterns in monthly energy usage

Total monthly energy usage	**Peak season (circle):** Summer Autumn Winter Spring All months similar irregular/other: _____ **As expected?** yes / no Notes:
Electricity usage	**Peak season (circle):** Summer Autumn Winter Spring All months similar irregular/other: _____ **Electric fuel source?** AC: yes / no Heat: yes / no **Pattern as expected?** yes / no Notes:
Gas/Oil usage	**Peak season (circle):** Summer Autumn Winter Spring All months similar irregular/other: _____ **Primary gas/liquid fuel:** natural gas oil propane other: _____ **Gas/oil fuel source?** Heat: yes / no AC : yes(unusual) / no **As expected?** yes / no Notes:

Technical Elements: Monthly Data and Benchmarking

Retail Store:

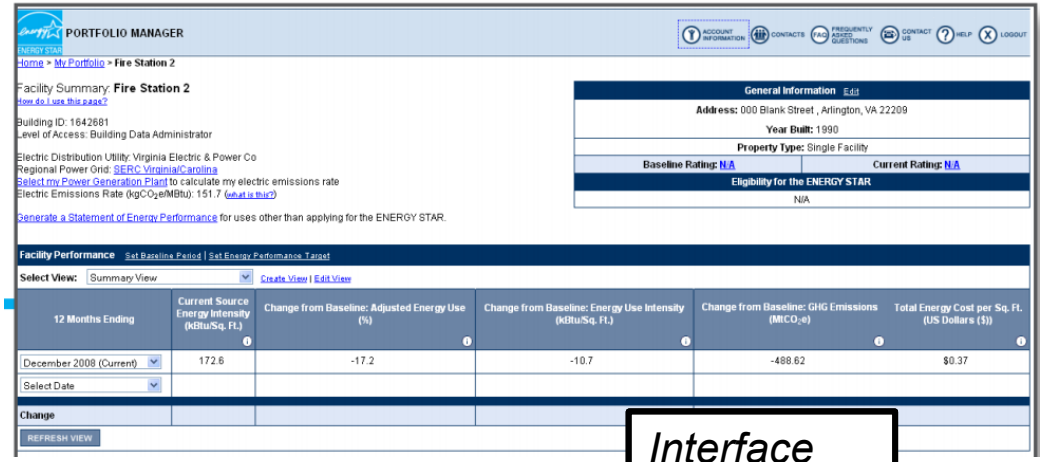
Required:

_____ **Gross floor area (SF)**
_____ Weekly operating hours
_____ # of workers on main shift
_____ # of personal computers
_____ # of cash registers
_____ # of walk-in refrigeration/freezer units
_____ # of open & closed refrigeration/freezer cases
_____ Percent of floor area that is cooled in 10% increments (10%, 20%, 30%, etc.)
_____ Percent of floor area that is heated in 10% increments (10%, 20%, 30%, etc.)
_____ Exterior entrance to the public – yes or no

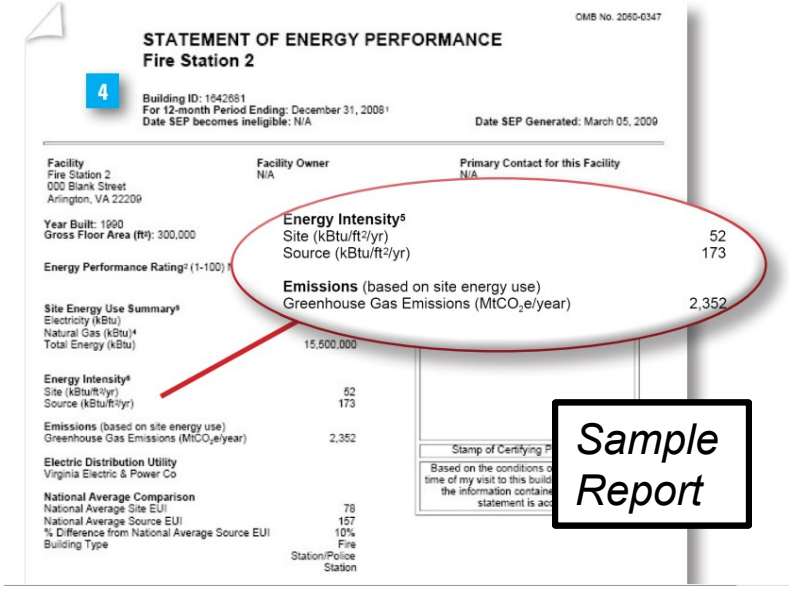
Template for data logging

Portfolio Manager

www.energystar.gov/benchmark



Interface Screenshot

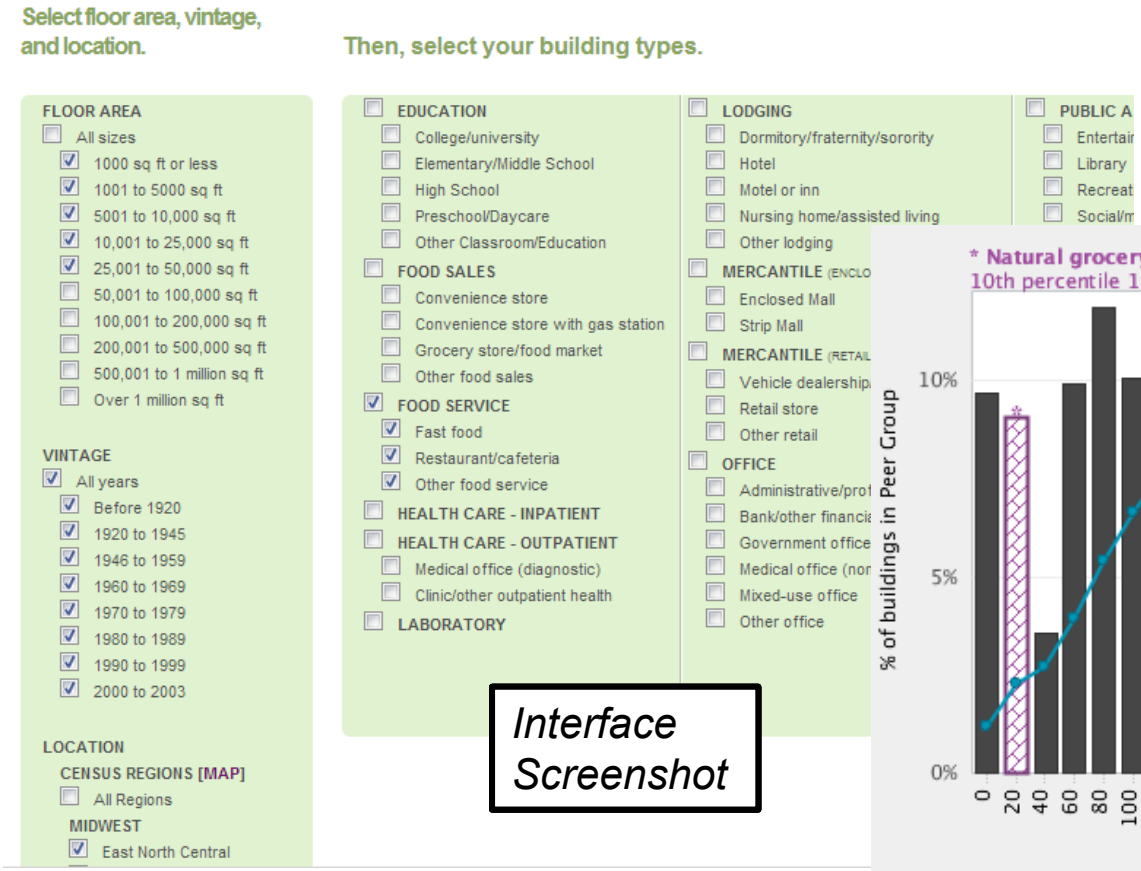


Sample Report

Technical Elements: Monthly Data and Benchmarking

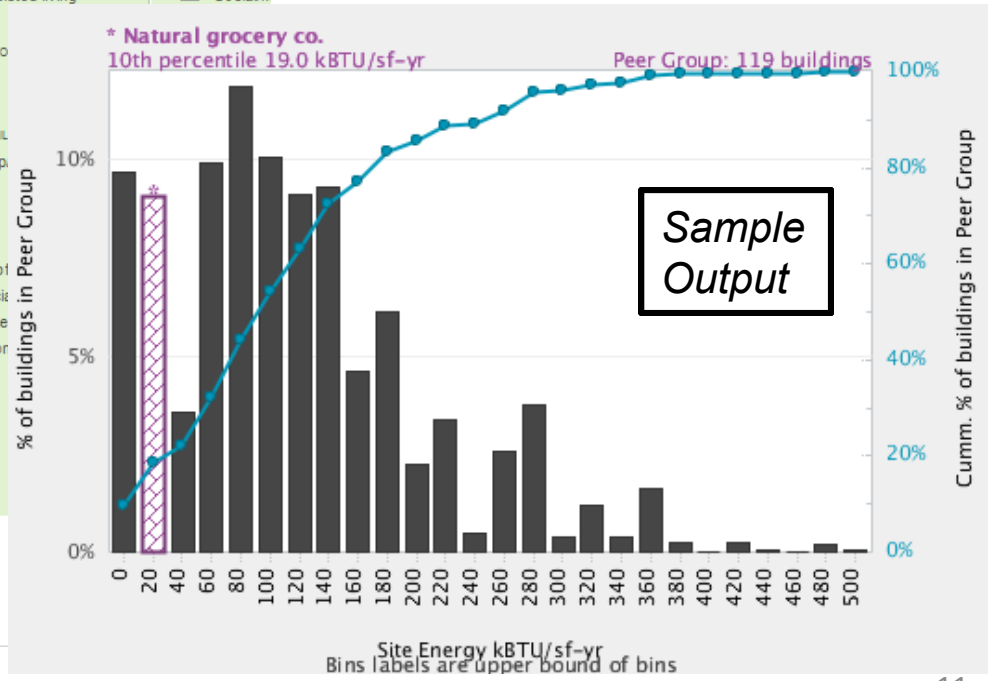
EnergyIQ
ACTION-ORIENTED ENERGY BENCHMARKING

EnergyIQ.lbl.gov



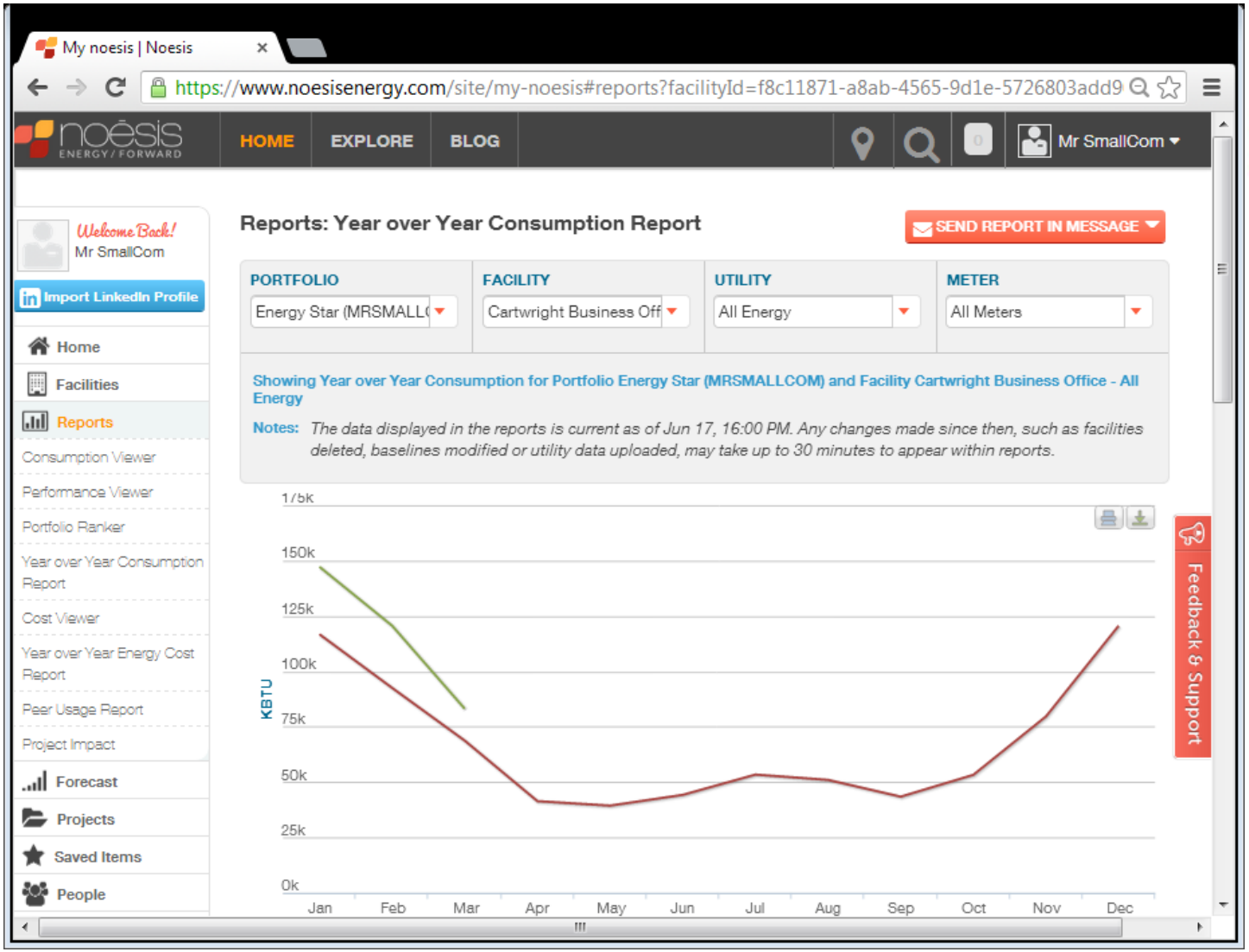
Interface Screenshot

"10% of peer buildings are more efficient than your building"



Sample Output

Technical Elements: Monthly Data & Benchmarking



noēsis ENERGY / FORWARD

Sample output

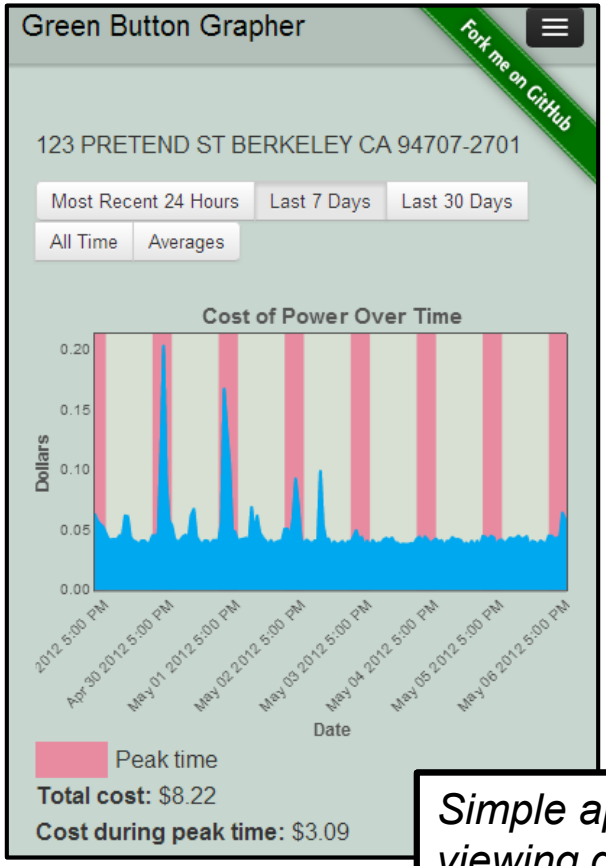
Technical Elements: Interval Data

What does this element offer?

- Identify patterns in usage to modify base load and schedule to reduce energy use
- Identify unusual activity & malfunctions

What would the package provide?

- Guidelines for tool use and analysis
- Worksheet
- Description, URL & sample reports for available tools
- Tips on interpreting interval data



Simple app for viewing data

E2 Interval Data Analysis Guidelines

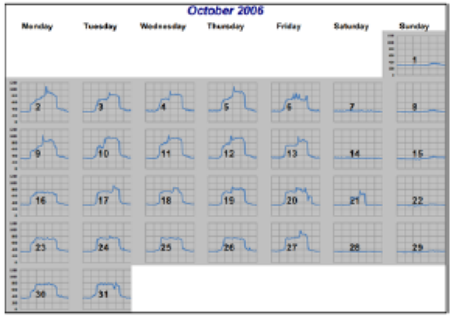
Plan to spend about 20-30 minutes reviewing a building's interval energy use data.

STEP 1 Upload data

Load interval data into the program. You need at least one month (as much as 6-13 months for some tools) of electricity use data reported every hour (or every 30, 20, 15 minutes). See 'Obtaining Interval Data'. At the end of this document, there is a list of tools that can be used for the analysis in this element.

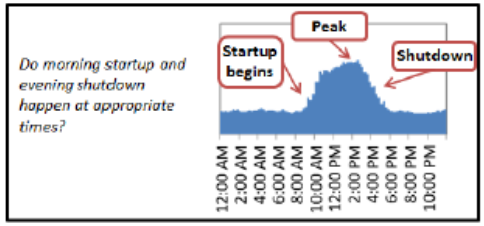
STEP 2 Daily and weekly load schedule

Display electricity use data vs. time for a few weeks of interval energy use data.



Energy use for each day in the month of October 2006 using ECAM (from ECAM instruction manual). Note weekday vs. weekend schedule is typical, with abnormal activity on Saturday October 21.

Does the daily load profile have the same shape as you would expect? Specifically:



E2 Interval Data Analysis Worksheet

Building:_____
Date:_____

STEP 1: Obtain & upload interval energy use data

Either: ☐ Get file from owner. File name: _____

☐ Download file from utility website (recommended)

Filename: _____ Utility: _____

Username:_____ Password: _____

Building floor area: _____ **Operating hours**:_____

Building type:(circle): office retail food service food sales other_____

Tool used to display interval data: _____

STEP 2 Daily and Weekly Scheduling:

☐ Printed a plot of a week or several weeks of daily loads

Weekly pattern (circle): Weekend load compared w/ typical: As owner expected?	all days similar weekday/weekend weekday/Sat/Sun irregular/other: _____ same slightly lower much lower base load level yes / no
Holiday loads compared w/ typical: Which holidays (circle): As owner expected?	same slightly lower much lower base load level 1/1 MLK Pres. Mem. July4 Labor Colum. Vet. ThnksGiv 12/24 12/25 other:_____ yes / no
Typical day scheduling: As owner expected?	Startup begins: _____ Startup ends: _____ Shutdown begins:_____ Shutdown ends:_____ yes / no
Notes on irregular activity: *Include times where equipment may be running unnecessarily.*	

STEP 3 Base Load:

Base load level: _____ Typical daily maximum level _____
Base load to daily maximum ratio: _____ *Divide base load by typical daily max*
• *If ratio above is greater than 0.50, look for opportunities to deepen setbacks.*

Technical Elements: Interval Data

ENERGY aI™
Actionable Information for Energy Savings

- $20 per load, PDF report
- Requires 6-13 months of hourly electricity use data

Sample report page

Shutdowns

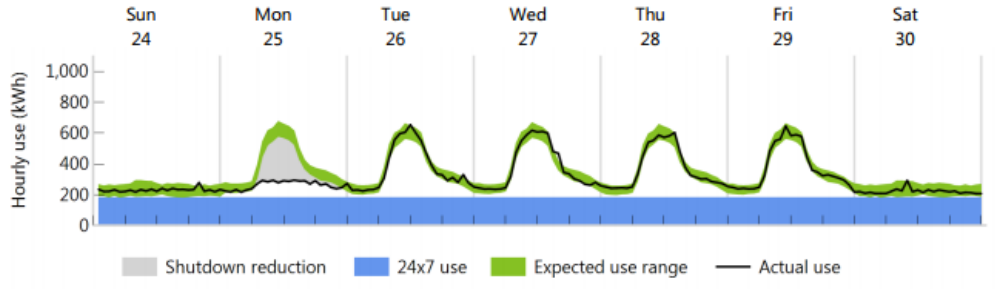
8 days Number of "shutdown" days in the analysis period - electricity use was much lower than expected, and was flat for most of the day.

16,700 kWh Reduced electricity use during the shutdown days. If use had been in the "expected range" for these days, this is how much additional electricity would have been used.

$2,250 Estimated cost savings from the reduced electricity use.

A "shutdown day" occurs when equipment which can be turned off is shut down for most hours of the day. This is a day when the load is expected to rise and fall, but instead is flat and near the 24x7 demand. Shutdown days often occur around holidays.

For example, the week beginning Sunday, 24 May 2009 has one shutdown day:



The 8 shutdown days occurred in 5 periods:

Shutdown Period	Reduced use (kWh)	Reduced cost ($)	Holidays
Mon, 25 May 2009	2,180	294	Memorial Day
Mon, 7 Sep 2009	2,620	405	Labor Day
Sat, 10 Oct - Mon, 12 Oct 2009	5,060	704	Columbus Day
Wed, 11 Nov 2009	2,050	250	Veterans Day
Thu, 26 Nov - Fri, 27 Nov 2009	4,830	592	Thanksgiving Day

Technical Elements: Walkthrough

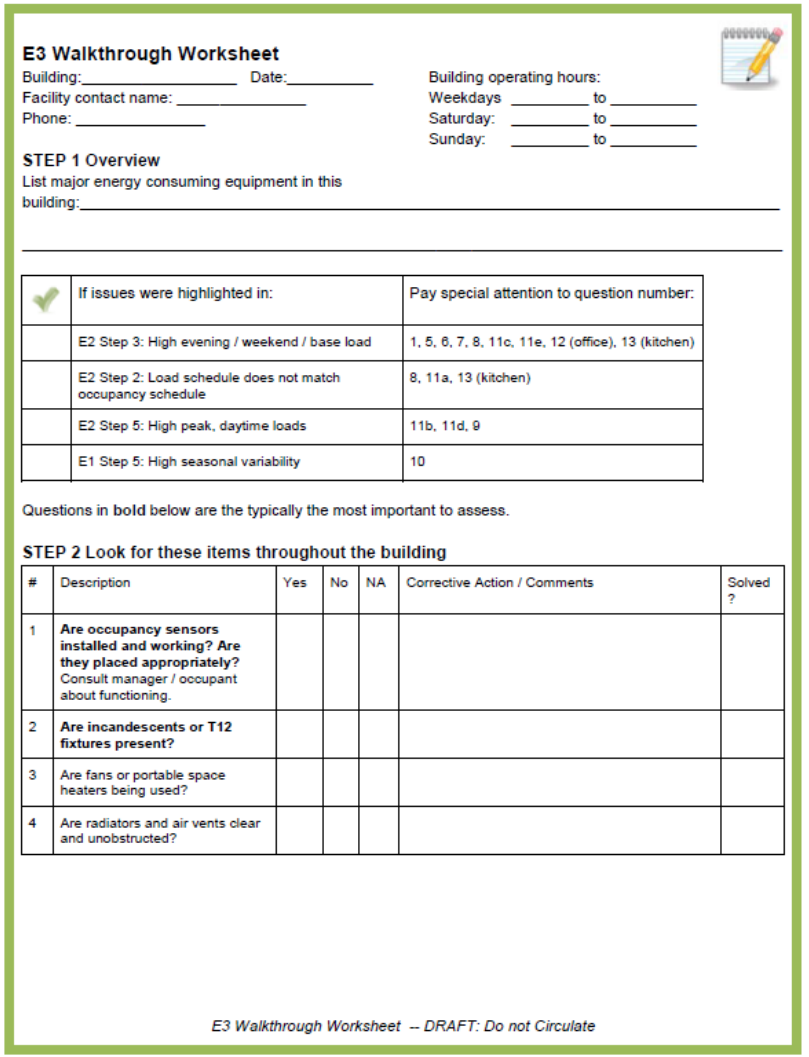
What does this element offer?

- Identify low-cost opportunities for energy savings
  - *Apply/increase thermostat night setbacks*
  - *Increase thermostat deadbands*
  - *Improve lighting schedule / control*
  - *Improve plug load schedule / control*
- *Not a full energy audit*

What would the package provide?

- Checklist of what to look for
- Information on how to identify problems

flickr.com/ along1085



E3 Walkthrough Worksheet

Building:_____ Date:_____
Facility contact name: _____
Phone: _____

Building operating hours:
Weekdays _____ to _____
Saturday: _____ to _____
Sunday: _____ to _____

STEP 1 Overview

List major energy consuming equipment in this building:_____

✔	If issues were highlighted in:	Pay special attention to question number:
	E2 Step 3: High evening / weekend / base load	1, 5, 6, 7, 8, 11c, 11e, 12 (office), 13 (kitchen)
	E2 Step 2: Load schedule does not match occupancy schedule	8, 11a, 13 (kitchen)
	E2 Step 5: High peak, daytime loads	11b, 11d, 9
	E1 Step 5: High seasonal variability	10

Questions in **bold** below are the typically the most important to assess.

STEP 2 Look for these items throughout the building

#	Description	Yes	No	NA	Corrective Action / Comments	Solved ?
1	**Are occupancy sensors installed and working? Are they placed appropriately?** Consult manager / occupant about functioning.					
2	**Are incandescents or T12 fixtures present?**					
3	Are fans or portable space heaters being used?					
4	Are radiators and air vents clear and unobstructed?					

E3 Walkthrough Worksheet -- DRAFT: Do not Circulate

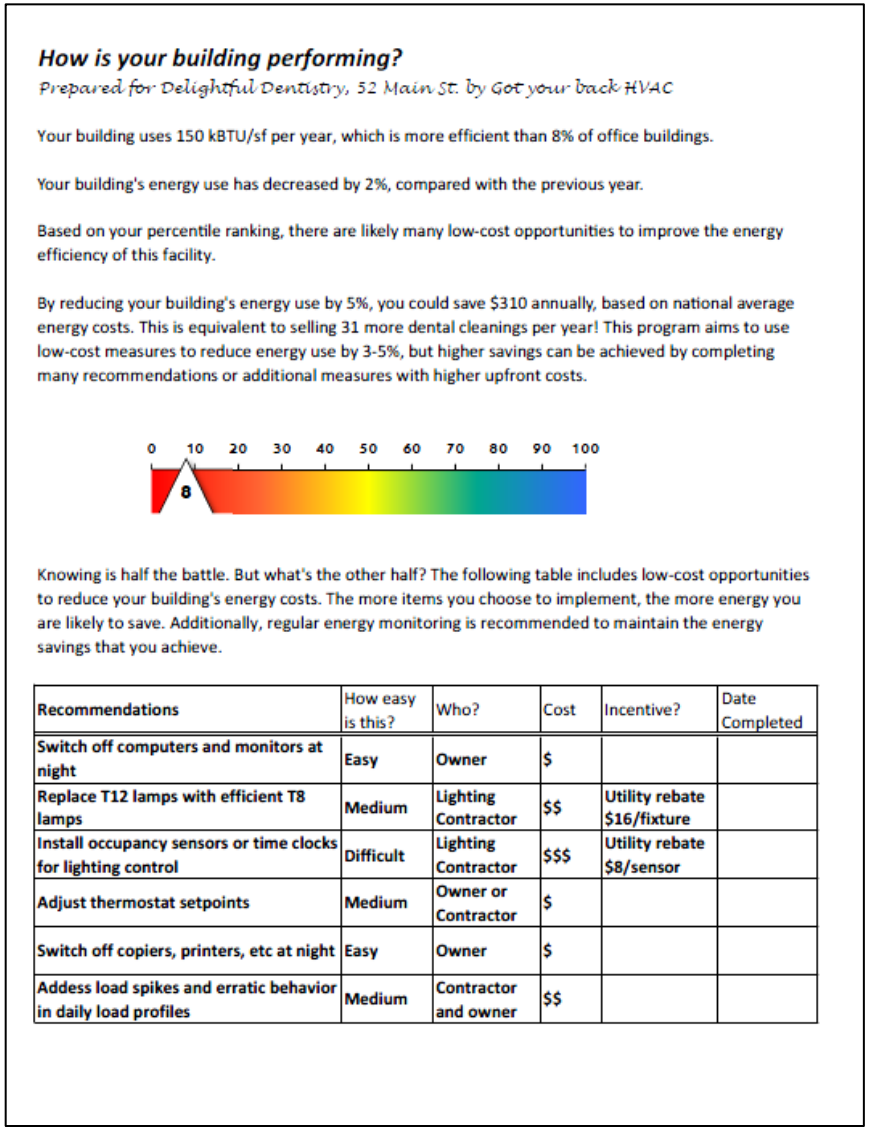
Technical Elements: Communicate with Owner

What does this element offer?

- Streamline the transfer of information to the building owner / operator
- Facilitate discussion of how to set goals and sell upgrades
- Identify relevant energy efficiency rebates & incentives

What would the package provide?

- Template to compile results from different tools
- Guidelines for communication and goal-setting with building owner



How is your building performing?

Prepared for Delightful Dentistry, 52 Main St. by Got your back HVAC

Your building uses 150 kBTU/sf per year, which is more efficient than 8% of office buildings.

Your building's energy use has decreased by 2%, compared with the previous year.

Based on your percentile ranking, there are likely many low-cost opportunities to improve the energy efficiency of this facility.

By reducing your building's energy use by 5%, you could save $310 annually, based on national average energy costs. This is equivalent to selling 31 more dental cleanings per year! This program aims to use low-cost measures to reduce energy use by 3-5%, but higher savings can be achieved by completing many recommendations or additional measures with higher upfront costs.

Knowing is half the battle. But what's the other half? The following table includes low-cost opportunities to reduce your building's energy costs. The more items you choose to implement, the more energy you are likely to save. Additionally, regular energy monitoring is recommended to maintain the energy savings that you achieve.

Recommendations	How easy is this?	Who?	Cost	Incentive?	Date Completed
Switch off computers and monitors at night	Easy	Owner	$		
Replace T12 lamps with efficient T8 lamps	Medium	Lighting Contractor	$$	Utility rebate $16/fixture	
Install occupancy sensors or time clocks for lighting control	Difficult	Lighting Contractor	$$$	Utility rebate $8/sensor	
Adjust thermostat setpoints	Medium	Owner or Contractor	$		
Switch off copiers, printers, etc at night	Easy	Owner	$		
Addess load spikes and erratic behavior in daily load profiles	Medium	Contractor and owner	$$		

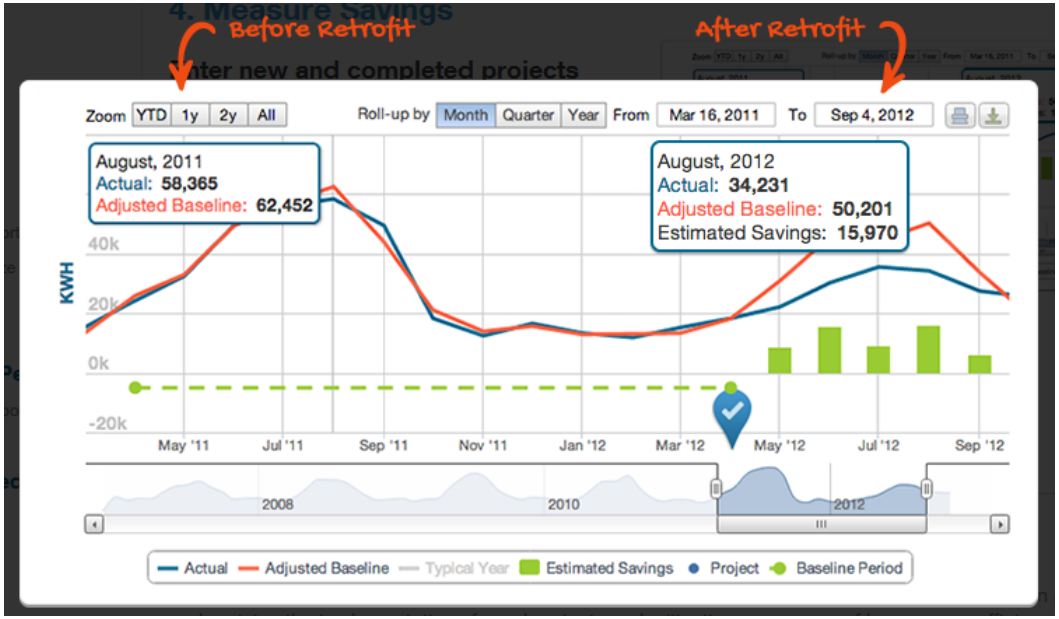
What does this element offer?

- Establish baseline performance
- Continuous tracking of performance
- Quantify cumulative savings & impact

What would the package provide?

- Guildelines on how to track performance & verify results
- Worksheet

flickr.com/ 401(K) 2013



Sample output

Market Potential and Business Plan

Why would a contractor participate?

- Differentiate your company
- Offer added value to customers through savings
- Identify additional service opportunities
- Gain credibility through established programs

How would package be financed?

- Embed costs into maintenance contracts

  "Rather than charging $1500/yr, I would charge $1700 or $1750, and incorporate this into what I would offer them…. you're adding value in the maintenance spiel and can monitor usage" – contractor interviewee

- Cost may be offset by building client base

How could utilities support the program?

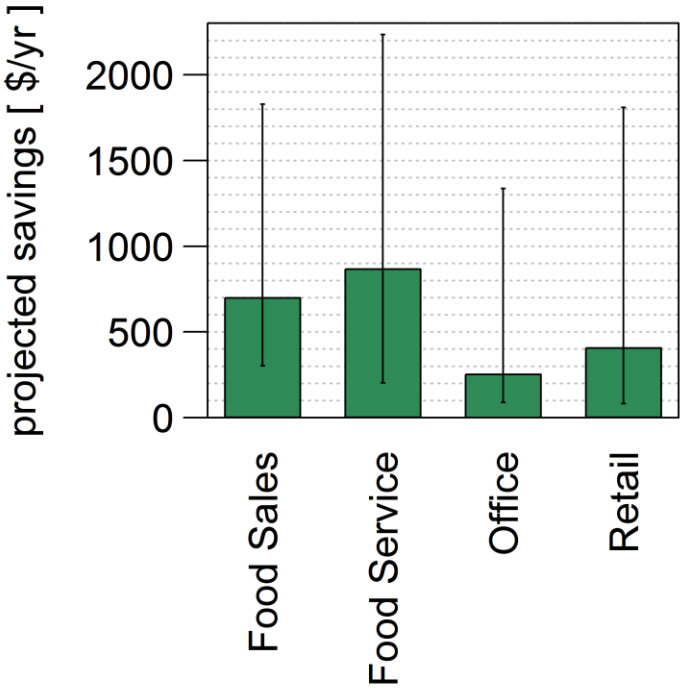
- Provide incentives, rebates or incremental billing

  "No one is budgeting for [energy efficiency services]. Some utilities have used incremental billing where $5 a month is tacked on to bill… reducing initial costs is key to doing this work." – utility program manager

- Provide recognized program affiliation for contractor. Contractors report utility program affiliation boosts business significantly.

What is the energy savings potential?

Operations and control measures	Simple Payback Time [years]
Implement advanced reset of HVAC processes	0.7
Chiller or boiler start/stop (environmentally determined)	0.4
Scheduling (occupancy determined)	0.3
Modify setpoint	0.1



Assuming 5% savings (based on building commissioning results of Mills, 2009)

→ Median savings of $200-900

→ 10% with highest energy use: savings of $1300-$2300

Based on total annual fuel expenditure for buildings <50k sf (CBECS, 2003)

How is this financed?

	Costs	Revenue/Benefits	Value to Client
Embed in maintenance contracts	• 4 hours, 2x per year (once trained) • Use billing rate or cost rate for labor??	• Premium on maintenance contract (~$200??) • Customer retention • Customer trust , more referrals	• Savings minus premium (~up to $700/yr) • Awareness, peace of mind, green business
Separate offering	Same as above	Cost + 10%??	Savings minus price (reduced from above)

What would a reasonable labor rate be?
How much do you expect you could increase the premium?
How important is customer retention / acquisition ($)?

Deployment channels: from lab to contractors

- Contractor training
- Contractor professional organizations: state/local chapters
- Cities and States with energy use reporting requirements
- Utility programs working with small businesses
- Building Owners and Managers Association (BOMA)
- Environmental business certification bodies e.g., Green Seal

Project Demonstration Timeline

Jan 2013
- Draft technical features & business model
- Establish Partnerships

Feb-Mar 2013
- Refine package and business model with partner feedback

Apr-Jul 2013
- Deploy package with 2 partners in 2 buildings each

Sept 2013
- Assess deployment, refine approach